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PERFORMANCE TEST ON SINGLE CYLINDER DIESEL ENGINE WITH PINE BIO-DIESEL AND 1-HEXANOL AS IGNITION IMPROVER

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ABSTRACT:
The increasing industrialization and Motorization of the world has led to a steep rise for the demand of petroleum products. Petroleum based fuels are obtained from limited reserves. In the wake of this situation, there is an urgent need to promote use of alternative fuel which must be technically feasible, economically competitive, environmentally acceptable and readily available. In the present study, Pine seed oil methyl esters (PSOME) were blended with Diesel (20,30,40% on volume basis) and various chemical and performance characteristics were evaluated on compression ignition engine and results compared with baseline data of Diesel. Addition of 1-Hexanol (Ignition Improver) 0.5% volume ratio of the optimum blend (PSOME40) for evaluating the engine performance and the main purpose of ignition improver is to improve the combustion process. Finally results shown that performance has been to justify the potentiality of Pine seed oil methyl esters as alternative fuel for compression ignition engines without any modifications.

1.INTRODUCTION:

Considering the future energy security, sustainability and environmental damage, the study on various alternate, clean and renewable sources of fuel has grabbed the interest and attention of many researchers. Among which, biodiesel is one of the most commonly used alternative fuel for diesel engine. Biodiesel is normally produced from vegetable oil or animal fats through Transesterification in the presence of catalyst at elevated temperature, while higher fatty acid oil even demands double stage Transesterification process. The conversion of triglycerides into methyl or ethyl esters, through the transesterification process, reduces the molecular weight to one-third that of the triglyceride and also reduces the viscosity by a factor of about eight, with a marginal increase in volatility. Thus, after trans-esterification process, the properties of the biodiesel are so conducive for its use in diesel engine. Recent studies on engine performance using biodiesel have shown significant improvements when compared to that of diesel. Furthermore, emissions such as smoke, HC (hydrocarbon), CO (carbon monoxide) and CO2 (carbon dioxide) were also found to be reduced at the expense of slight increase in NOx (oxides of nitrogen).

1.1 Bio Fuel

A biofuel is a fuel that is produced through contemporary biological processes, such as agriculture and anaerobic digestion, rather than a fuel produced by geological processes such as those involved in the formation of fossil fuels, such as coal and petroleum, from prehistoric biological matter.

Biofuels can be derived directly from plants, or indirectly from agricultural, commercial, domestic, and/or industrial wastes. Renewable biofuels generally involve contemporary carbon fixation, such as those that occur in plants or microalgae through the process of photosynthesis. Other renewable biofuels are made through the use or conversion of biomass (referring to recently living organisms, most often referring to plants or plant-derived materials). This biomass can be converted to convenient energy-containing substances in three different ways: thermal conversion, chemical conversion, and biochemical conversion. This biomass conversion can result in fuel in solid, liquid, or gas form. This new biomass can also be used directly for biofuels.

2. REVIEW OF LITERATURE

Vern Hofman and Elton Solseng et al [1],

They were conducted experiments on four cylinders Cumming diesel engine with **sunflower oil** with diesel blends finally suggested Biodiesel has lower energy content and the power output of

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the engine decreased by almost 9% on pure biodiesel. This would mean that more fuel would be needed to do the same work as diesel fuel. About 1.1 gallons of biodiesel would be needed to do the same amount of work as diesel fuel.

Two significant problems exist as to the acceptance of biodiesel by the public. They are the added cost for the fuel and fuel thickening in cold weather. The thickening problem can be handled with fuel heaters. The added cost will need to be accepted by the consumer or a government subsidy will be needed or the price of diesel fuel rises to a similar level.

S. Jai Chandar and K. Annamalai et al [2],

This paper reviews the history of biodiesel development and production practices. In this investigation they were used **different vegetable oils** for observations. Fuel-related properties are reviewed and compared with those of conventional diesel fuel. They conclude the problems with substituting vegetable oil for diesel fuels are mostly associated with their high viscosities, and low volatilities. The viscosity of vegetable oils can be reduced by Tran's esterification. Transesterification is the most common method and leads to mono alkyl esters of vegetable oils and fats, known as bio-diesel. The production of biodiesel from vegetable oil is very simple. In the production of biodiesel, it is observed that the base catalyst performs better than acid catalysts and enzymes. The biodiesel and their blends have similar fuel properties as that of diesel. It is also observed that biodiesel has similar combustion characteristics as diesel. Biodiesel engines offer acceptable engine performance compared to conventional diesel fueled engines.

The main advantage in biodiesel usage is attributed to lesser exhaust emissions in terms of carbon monoxide, hydrocarbons and particulate matter. Biodiesel is said to be carbon neutral as more carbon dioxide is absorbed by the biodiesel yielding plants than what is added to the atmosphere when [burnt] used as fuel. Even though biodiesel engines emits more NOx, these emissions can be controlled by adopting certain strategies such as the addition of cetane improvers, retardation of injection timing, exhaust gas recirculation, etc.

The objectives of acceptable thermal efficiency, fuel economy and reduced emissions using biodiesel in CI engines are attainable, but more investigations under proper operating constraints with improved engine design are required to explore the full potential of biodiesel engines .

N.L. Panwar et al [3],

In this investigation, castor methyl ester (CME) was prepared by transesterification using potassium hydroxide (KOH) as catalyst and was used in four stroke, twin cylinder variable compression ratio type diesel engine. Tests were carried out at a rated speed of 1500 rpm at different loads.The engine performance was analyzed with different blends of biodiesel and was compared with mineral diesel. It was concluded that the lower blends of biodiesel increased the break thermal efficiency and reduced the fuel consumption. The exhaust gas temperature increased with increasing biodiesel concentration. The results proved that the use of biodiesel (produced from castor seed oil) in compression ignition engine is a viable alternative to diesel. Carbon dioxide and unburned hydro carbon were marginally higher than that of the diesel baseline. The toxic gas carbon monoxide emission of waste plastic oil was higher than diesel. Smoke reduced by about 40% to 50% in waste plastic oil at all loads.

3.MATERIALS AND METHODS

3.1 MATERIALS

In this project we tried to investigate the potential use pine Oil Methyl Ester (POME). Various experiments were conducted on POME and the results were recorded. We collected the results of Pine Oil Methyl Ester from various journals and research papers. The results of POME were compared with conventional diesel. A brief introduction about the material used in this project is given below.

3.2 PINE OIL

In this study, oil derived from oleoresins of tree, widely grown for its bark, wood, tar and essential oil, has been decidedly chosen to be used as fuel for diesel engine. oil, stable under all conditions of use and storage, is unique in that the feedstock originates from the forest and can be

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blended with Petro-based diesel fuel readily . For the current study, gum oil is being used and extracted from oleoresin, which is traditionally obtained from tree by the process of tapping. This essential oil, obtained from tree, is pale yellow in color with fresh forest smell and is soluble in alcohols and other mineral oils. The estimated world production of oil was reported to be 30,000 tons per annum and the demand for oil by 2022 was predicted to be 853,894 tons. The constituents of oil are Petrol, which is a tertiary alcohol, Dipentene (an isomer of ne), unreacted ne and some minor quantities of other by-product and impurities. The ane, collected from tree, has been converted in to Aterol ($C_{10}H_{18}O$) by acid-catalyzed hydration process. It could be comprehended from the molecular formula of oil that it contains inherent oxygen within the structure, which is obtained as the result of the hydration reaction, catalyzed by an acid. Similar to lower alcohols such as ethanol and methanol, oil has C, H and O atoms in its structure, emerging as a renewable feedstock in the realm of other alternate fuels. However, contrary to other alcohol type of fuels, oil has higher calorific values, which make it as one of the appropriate biofuel to be used in diesel engine. Moreover ,oil has lower viscosity and boiling point, which could increase the fuel atomization and its vaporization. All the other properties of oil, determined by ASTM methods, comply with the standards and it qualifies as a potential candidate for diesel engine.

3.3 TRANSESTERIFICATION PROCESS

INTRODUCTION

There are so many investigations on bio-diesel production of non-conventional feedstock of oils have done in last few years. Overview of transesterification process to produce biodiesel was given for introductory purpose. It is reported that enzymes, alkalis, or acids can catalyse process. Alkalis result in fast process. It is mentioned that catalysed process is easy but supercritical method gives better result. Adaptation of the vegetable oil as a CI engine fuel can be done by four methods Pyrolysis, Micro emulsification, Dilution, and Transesterification. Out of these in this study transesterification process is used.

Properties of Fuel:

Properties	Diesel	Pine oil
Density(kg/m^3)	840	875
Calorific value(KJ/kg)	42390	44500
Cetane Number	46.4	51
Kinematic Viscosity(40^{0}C)	3.1	5.5
Flash Point(^{0}C)	54	65

Engine Specifications:

Model	AVP-1
Make	ANIL
Engine type	Single cylinder ,Four Stroke ,Water cooled Compression ignition engine
Bore	80mm
Stroke	110mm
Speed	1500rpm
Rated power	3.5/5H.P

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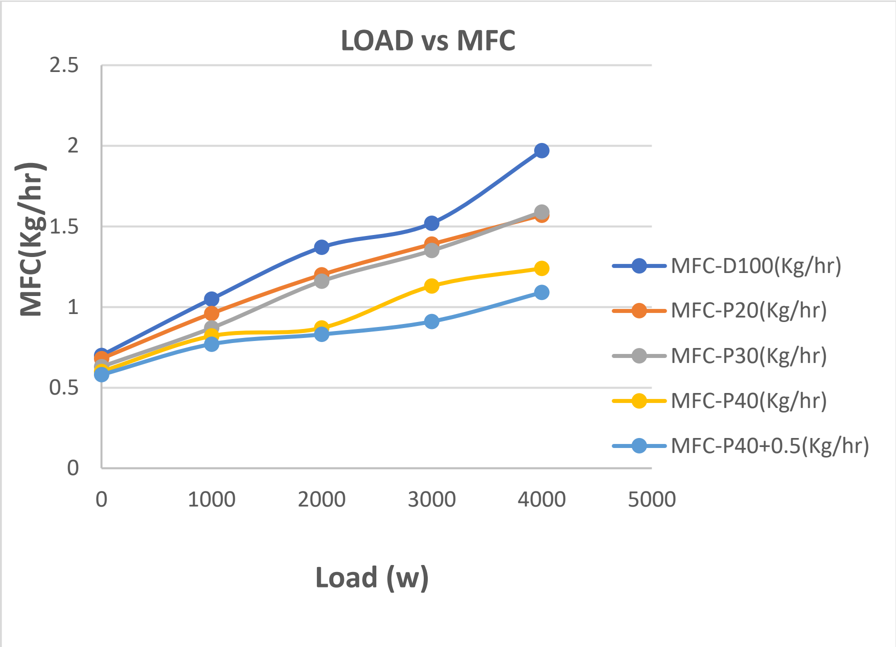
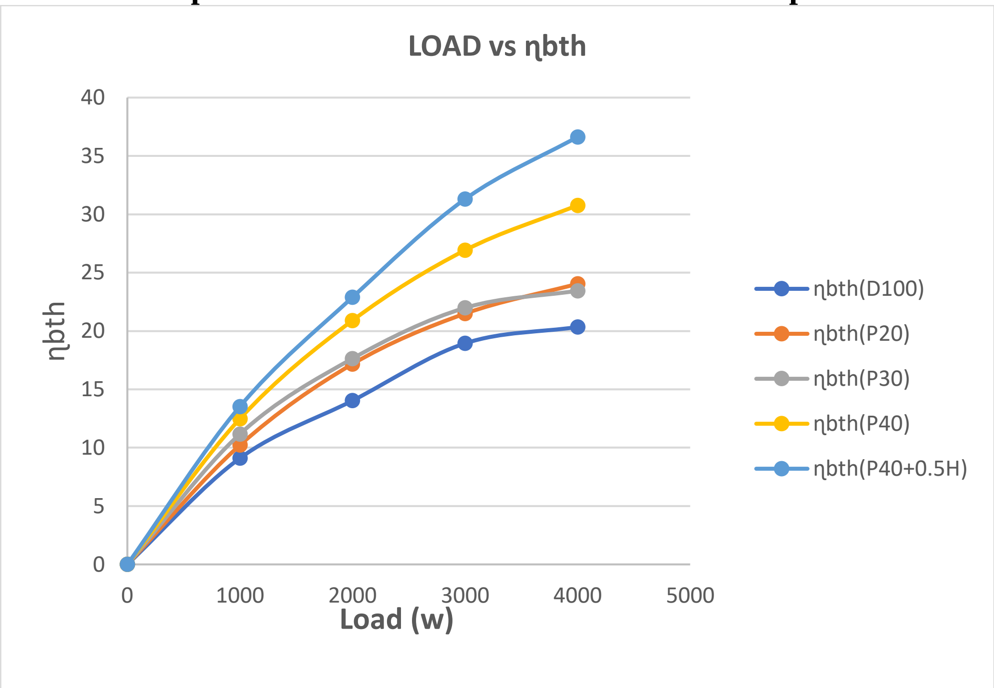
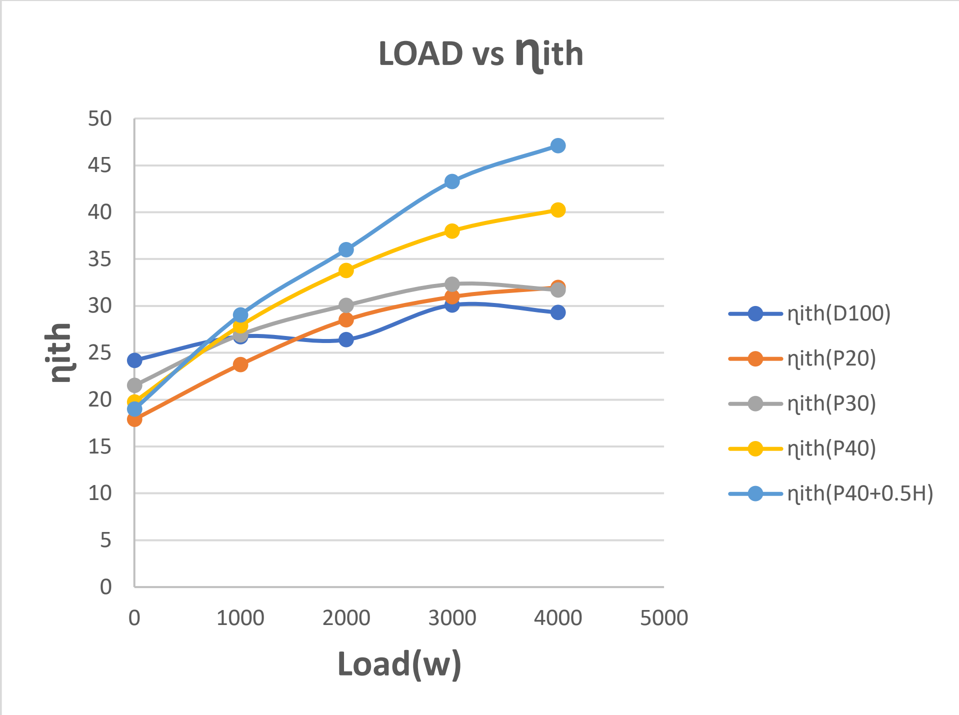
RESULTS AND DISCUSSIONS:



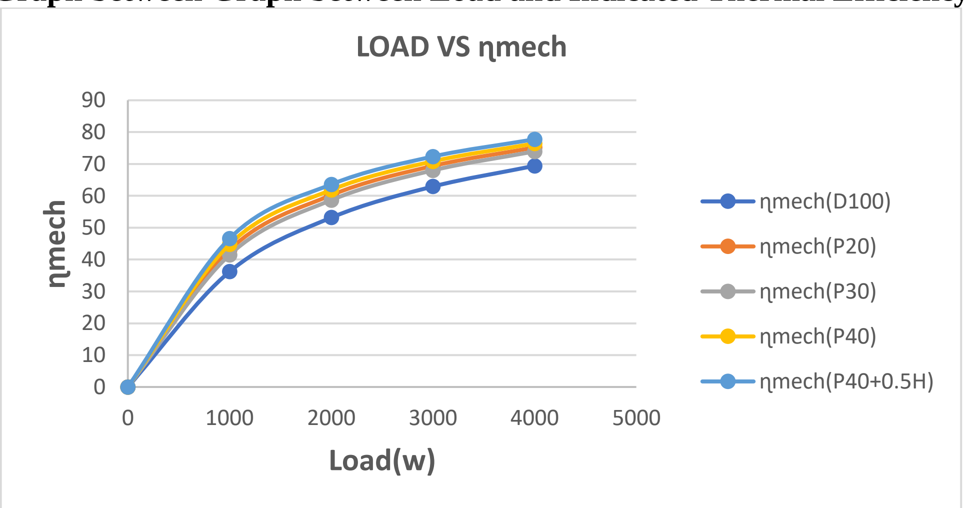
Graph between Load and Mass of Fuel Consumption



Graph between Load and Brake Thermal Efficiency



Graph between Graph between Load and Indicated Thermal Efficiency



Graph between Load and Mechanical Efficiency

CONCLUSION

Following are the conclusions based on the experimental results obtained while operating single cylinder air cooled diesel engine fuel with diesel and pine oil blends. The blends of pine oil shows lowest fuel consumption values than the diesel at all the loads Brake Specific Fuel Consumption is gradually decreasing for all the P-blends and also for P40+0.5%H.Brake thermal efficiency of the tested diesel engine is 11% improved when it is fuel with P-40 blend at full load(4000W), and 16.9% improved when it is fuel with P40+0.5%H at full load. Indicated thermal efficiency of the tested diesel engine is 11.8% improved when it is fuel with P-40 blend at full load(4000W), and 18.7% improved when it is fuel with P40+0.5%H at full load .Mechanical efficiency of the tested diesel engine is 7% improved when it is fuel with P-40 blend at full load(4000W), and 8% improved when it is fuel withP40-0.5%H at full load.

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